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GB 2187295 A **GB 2127558 A**

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UK CL (Edition K) **G1S SEJ SEK SEM**
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Online databases: WPI

(54) Consistometer for measuring rheological change

(57) A consistometer, includes, a cylindrical receptacle (3) containing the substance which is to be analysed, means to control temperature and pressure within the receptacle, and an internal rotary stirring apparatus (7) moved by a drive mechanism (9) wherein the stirring apparatus is mounted on two centrally-located pivots (25, 33) positioned vertically opposite one another inside said receptacle. The stirrer carries a mass (21) coupled to a rotary magnet (45) positioned around the mass outside the receptacle in order to rotate said stirring apparatus. The magnet is linked to a drive mechanism, enabling the force required to drive the stirring apparatus and, hence the consistency of the substance which is being analysed to be measured and allowing its development to be measured against said temperature and pressure. The apparatus is used for determining setting times of cements for oil wells.

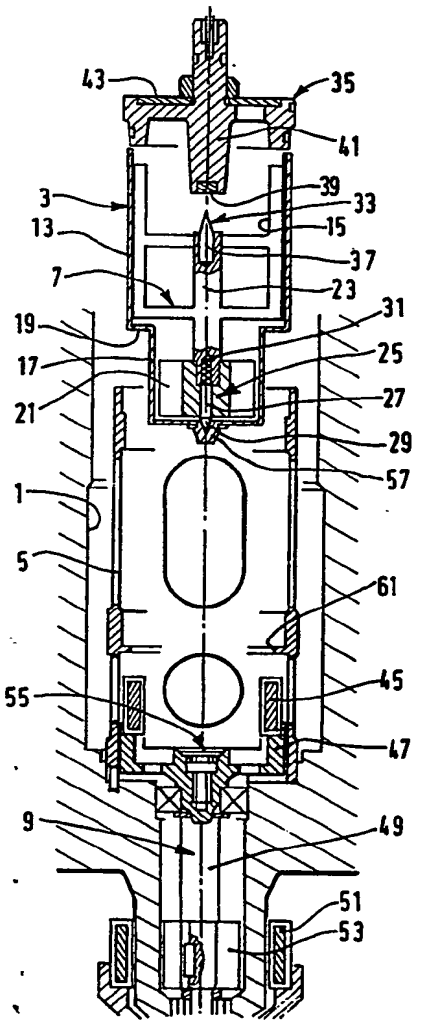

FIG.1

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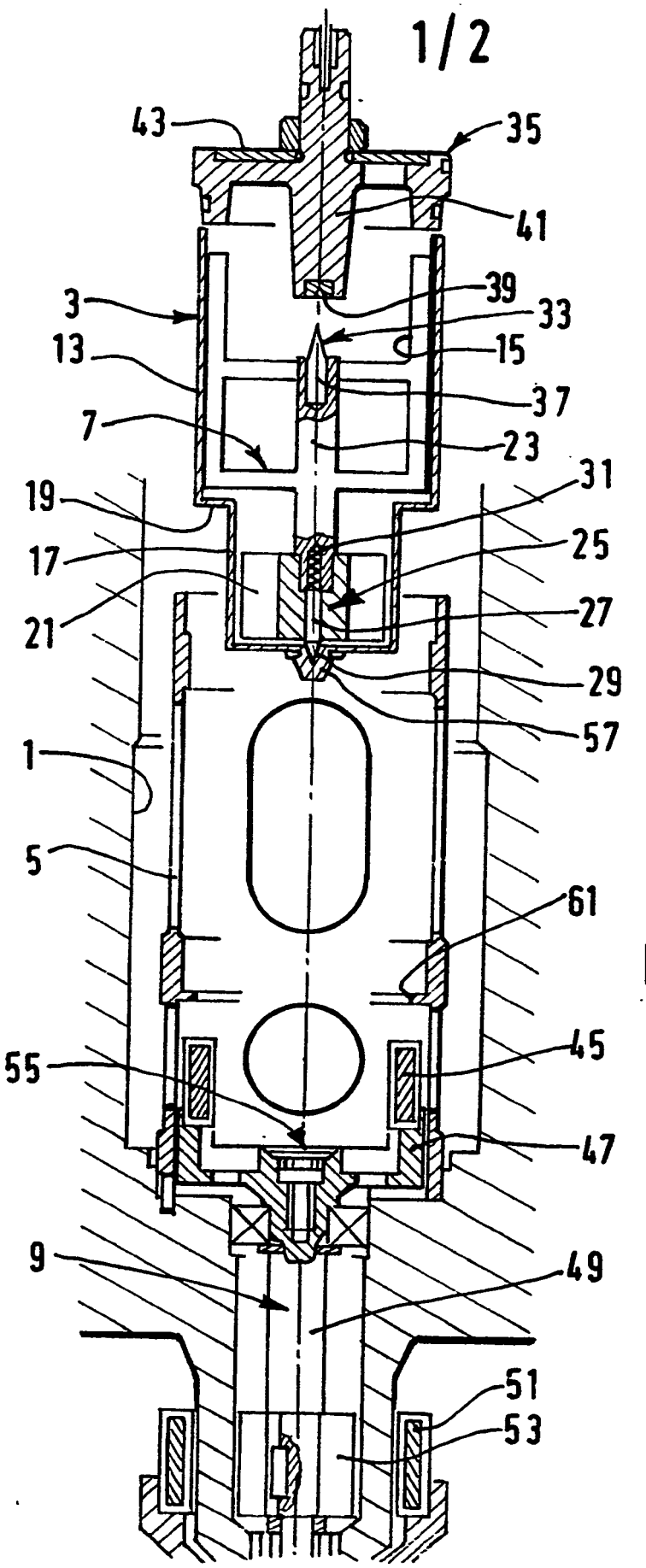

FIG.1

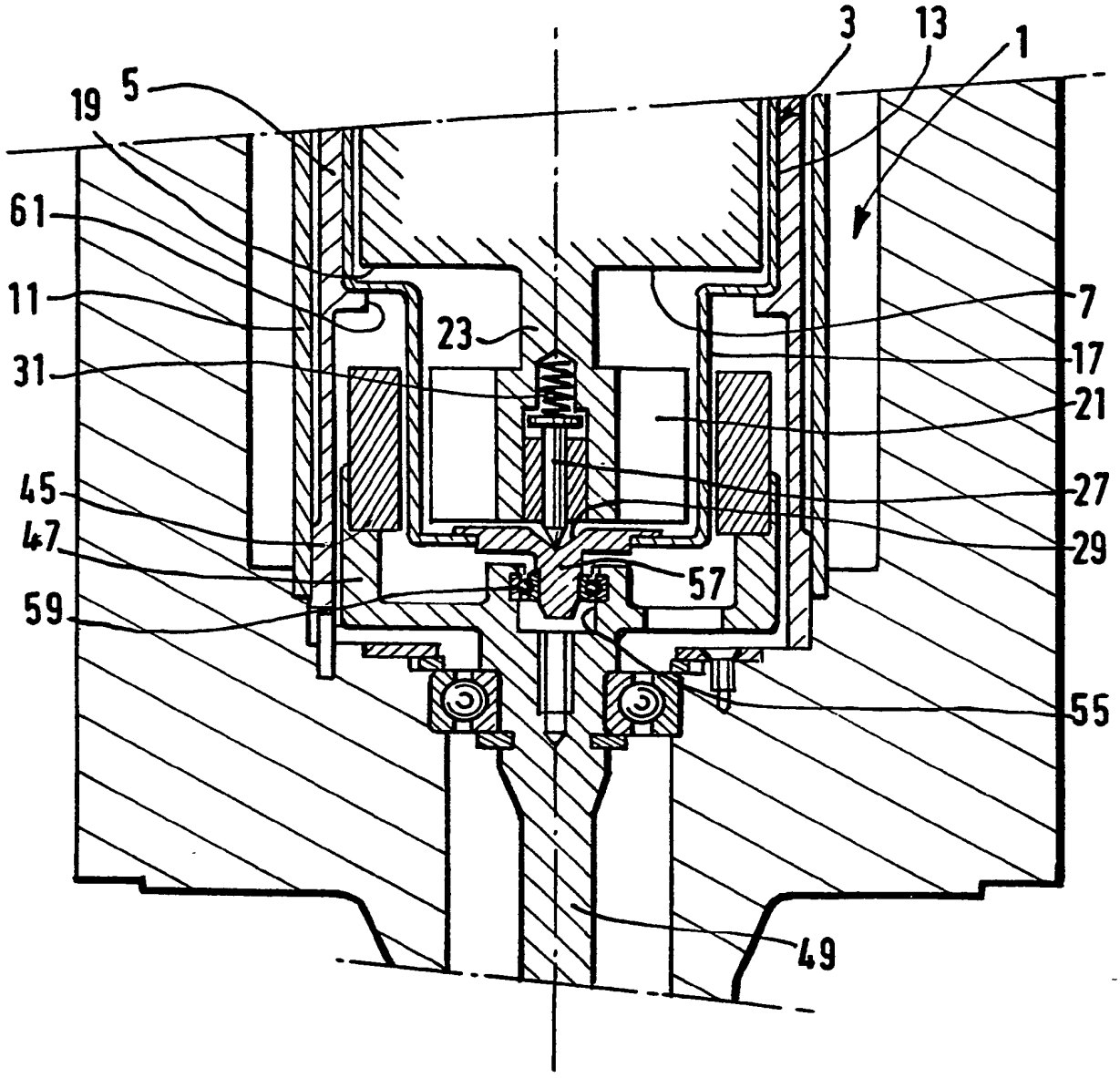

FIG.2

PLASTOMETER

The invention concerns a plastometer, in other words, an analytical device which may be used to measure rheological properties in substances and, in particular, the consistency, after a given period has elapsed, of a substance which is in the process of hardening.

One particularly important application for plastometers lies in the determination of setting times for the cements used in the construction of oil wells.

European patent No. 0 236 205 dated 17th February 1987 gives details of a plastometer consisting of a receptacle containing the substance which is to be analysed, this receptacle including an internal rotary stirring apparatus mounted on an axial drive rod which passes through the base of the receptacle via a shaft seal and extends downwards to a drive mechanism. During measurements, where this arrangement is employed, account has to be taken of parasitic sources of friction which are created as the rod passes through the shaft seal at the base of the receptacle. Furthermore, this seal cannot be guaranteed to be absolutely leak-proof.

The invention aims to remedy these deficiencies and proposes a plastometer of a type featuring, in the conventional manner, a cylindrical receptacle containing the substance to be analysed with the pressure and temperature suitably raised to the required level, this receptacle including an internal rotary stirring apparatus moved by a drive mechanism, with the characteristic feature that said stirring apparatus is mounted on two pivots positioned vertically opposite one another at the centre inside said receptacle, which is free to rotate about its vertical axis,

and that it features a polar mass which is suitable for connection to a rotary magnet fitted outside the receptacle surrounding the polar mass in order to rotate said stirring apparatus, said magnet being linked to its own drive mechanism, enabling the force required to drive the stirring apparatus and, as a result, the consistency of the substance being analysed, to be measured and allowing changes with the aforementioned temperature and pressure parameters to be measured.

The stirring apparatus has the benefit of one tip at its lower end, directed downwards, which, together with a matching housing at the base of the receptacle, forms a first pivot, and a second tip at the top, directed upwards, which, together with a matching housing formed axially in the cover of the receptacle, forms the second pivot to hold the stirring apparatus in position. One of the pivots may be spring-mounted in order to compensate for thermal expansion when the device is working.

The polar mass is formed in the lower part of the stirring mechanism, being essentially cylindrical in shape and designed to rotate with low dynamic resistance within the substance which is being analysed.

The receptacle takes the polar mass of the stirring apparatus in its lower part, with little lateral play relative to its wall. The lower and main parts of the receptacle are both cylindrical and they share a common axis, but the lower part has a diameter smaller than that of the main part, which houses the blades on the stirring apparatus.

The rotary magnet is ring-shaped. It forms an integral unit with its drive shaft; it is mounted inside the plastometer, on the base, and it rotates in a fixed plane. When the receptacle

is slotted into position in its supporting casing inside the receptacle, the latter is positioned in such a manner as to ensure that the rotary magnet surrounds its lower part at a short distance from its wall, which has the benefit of being manufactured in thin-gauge stainless steel designed to avoid any interference with or absorption of the rotating magnetic field emanating from the rotary magnet. Furthermore, the entire unit is symmetrical about its axis.

As a result of this arrangement, by virtue of the particularly straightforward and economical design of the receptacle, without any seal for the stirring apparatus drive shaft at the base of the receptacle, as required for the arrangement described above, which is already known, the receptacles filled with substance, along with their stirring apparatus, may be discarded after each test, thereby eliminating the need for the meticulous cleansing which has traditionally been needed for these.

An illustration of the invention is provided below, in the form of a model of the design and with reference to the appended drawing, in which :

- Figure 1 provides an exploded schematic transverse cross-sectional view of a plastometer as covered by the invention and
- Figure 2 provides a magnified partial cross-sectional view of the plastometer in operation.

In these figures, only those parts of the plastometer which are essential to give an understanding of the invention are represented.

These figures show the measurement chamber or cell 1 in the plastometer (shown in part), the receptacle 3 containing

the substance which is to be analysed (cement slag) with its support casing 5 , the stirring apparatus 7 with which the receptacle is fitted and the drive mechanism 9 for the stirring apparatus at the lower level.

The chamber 1 is cylindrical in shape and, when the device is working, contains the medium (oil) which is needed to set the variable pressure and temperature of the substance in the receptacle. The temperature is raised in a conventional manner, using heater elements 11 positioned inside the chamber. Conventional means are also used for pressurisation, which is achieved by transmitting pressure directly through the oil which is inside the chamber and above the cement slag in the receptacle. Pressure is obtained by means of an external hydraulic pump (which is not represented).

The receptacle consists of two adjoining cylindrical parts, the main part 13 housing the blades on the stirring apparatus and the lower part 17 , with a smaller diameter, separated by means of a cylindrical collar 19 from the main part 13. The lower part takes the lower polar mass 21 in the stirring apparatus drive with little lateral play. This polar mass is roughly cylindrical in shape, is manufactured in mild steel and forms an integral unit with the lower part of the axial rod 23 on the stirring apparatus, sharing a common axis with said rod.

The stirring apparatus is mounted on two pivots inside the receptacle, situated vertically opposite each other. The first pivot 25 is in the lower part. It is formed of an assembly with a lower tip which is integral with the stirring apparatus and a matching conical housing 29 formed in the base of the receptacle. This tip is mounted axially on the lower part of the

stirring apparatus rod 23 and emerges just below the polar mass 21 . This tip is drawn downwards by a spring 31 designed to absorb thermal expansion which occurs whilst the device is working. The second pivot 33 is opposite the former and situated roughly at medial level in the receptacle. It is formed by means of a cover 35 known as the central aligning unit, which is affixed to the upper aperture in the receptacle. It is formed in a manner similar to that in which the previous pivot is formed, with a tip 37 directed upwards and fixed axially at the upper end of the stirring apparatus rod 23 , this tip acting jointly in operation with a matching housing 39 formed in the socket 41 located centrally on the cover. This pivot is in a fixed location since, naturally, the cover is mounted in a fixed position onto the receptacle, unlike the previous pivot, which has scope for axial travel. Moreover, there is a sintered metal cap 43 on top of this cover, allowing the pressurised oil in the chamber to enter the receptacle and to keep the cement under pressure.

The stirring apparatus drive mechanism is of the rotary magnetic type 45 exciting the stirring apparatus by means of its polar mass 21 . The rotary magnet is ring-shaped and arranged axially in relation to the device, the magnet having a flat vertical profile. In its working position (with the receptacle inside the chamber), it is positioned within the space between the cylindrical perforated supporting casing 5 , into which the receptacle is slid, and the cylindrical wall of the lower part of the receptacle, just a short distance away from the latter. It is supported by radial arms 47 which are integral with a lower vertical drive shaft 49 which is permanently mounted beneath the chamber of the plastometer and which is in

the same axis as that of the receptacle. It turns horizontally in a fixed plane. The drive shaft is moved in a rotary pattern by an external magnetic clutch with a rotary magnet 51 and a polar mass 53 , similar to that used for the stirring apparatus immediately above it. The head of the shaft features a receptacle aligning hole 55 which accommodates a central lug 57 which forms an integral part of the base of the receptacle. This lug is slid into the ring inside a bearing 59 in situ within the hole.

It is a very simple matter to place the parts into their respective positions and to operate the device. First of all, the stirring apparatus is placed into the receptacle, on the lower pivot. The receptacle is positioned inside the casing 5 , at the lower part of which a circular rib 61 is applied. The receptacle is then filled with cement slag, the substance in which consistency is to be measured, after a given period of time, against temperature and pressure, and then closed with the centrally aligning cover, which is placed in position and secured over its aperture. The stirring apparatus is then perfectly secured on its upper and lower pivots.

The complete assembly is then placed in the chamber 1 , the lower lug 57 positioning itself in the central aligning hole 55 at the head of the drive shaft.

The device is then put into operation and measurements are recorded. Once the test has been completed, the filled receptacle and its stirring apparatus are discarded. Only the central alignment plug is recovered.

CLAIMS

1. A plastometer of a type comprising, in the conventional manner, a cylindrical receptacle (3) containing the substance which is to be analysed, set in an appropriate manner to the required pressure and temperature for measurement, this receptacle incorporating an internal rotary stirring apparatus (7) moved by a drive mechanism (9), said stirring apparatus being mounted on two central pivots (25, 33) positioned vertically opposite one another on the inside of said receptacle, with freedom to rotate about the axis, and comprising a polar mass (21) capable of being coupled to a rotary magnet (45) fitted on the outside of the receptacle around the polar mass for the purpose of rotating said stirring apparatus, said magnet being linked to its own drive mechanism, allowing the force required to turn the stirring mechanism and, hence, the consistency of the substance which is to be analysed to be measured, also allowing the progress of the substance under analysis to be measured against the parameters of temperature and pressure; wherein the polar mass (21) is formed at the lower end of the stirring apparatus with a basically cylindrical shape and designed to rotate with low dynamic resistance within the substance which is being analysed, said polar mass being accommodated within a lower cylindrical part (17) of the receptacle, which is surrounded by said rotary drive magnet (45) and fashioned with a reduced diameter relative to a main part (13) of the receptacle, the two parts being linked by a cylindrical collar (19); and wherein the receptacle (3) has an external central alignment lug (57) which is designed to engage in a matching hole (55) formed at the head of the drive shaft (49), whilst the receptacle (3) engages with a supporting casing (5) in situ within a chamber (1) by means of supporting rib (61).

2. A plastometer according to claim 1, wherein the

rotary magnet (45) is ring shaped, being driven in a fixed plane, together with the drive shaft (49) of which it is an integral part, in the space between the casing (5) in situ within the chamber and the lower part (17) of the receptacle which is being supported with little lateral play between the two, the entire assembly being symmetrical about its axis.

3. A plastometer according to claim 1 or claim 2, wherein the stirring apparatus (7) has a tip (27) at its lower end, this tip being directed downwards and, together with a complementary housing (29) at the base of the receptacle, forming a first pivot (25), and a second tip (37) directed upwards at its upper end, which, along with a complementary housing (39), made axially in a receptacle cover (35), constitutes the second mounting pivot (33) for the stirring apparatus.

4. A plastometer according to any one of the preceding claims, wherein one of the pivots (25,33) is mounted on a spring (31).

5. A plastometer according to any one of the preceding claims, wherein the wall of the receptacle (3) is manufactured in non-magnetic thin-gauge stainless steel.

6. A plastometer according to claim 3 wherein the cover (35), which forms a central aligning unit and which is mounted rigidly onto the receptacle, comprises an axial socket (41) at the end of which said housing (39) is formed.

7. A plastometer according to claim 6, wherein the cover (35) comprises a sintered metal cap (43) providing communication between the medium (oil) in the chamber (1) and the receptacle (3).

8. A plastometer substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition K) G1S (SEJ, SEK, SEM)

(ii) Int Cl (Edition 5) G01N 11/14

Search Examiner

V FLETCHER

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

19 AUGUST 1992

Documents considered relevant following a search in respect of claims 1-8

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2187295 A (TOTAL) Whole document	1
A	GB 2127558 A (AUTOCLAVE ENG.) Whole document	1

SF2(p)

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Category	Identity of document and relevant passages	Relevant to claim(s)

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X: Document indicating lack of novelty or of inventive step.

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